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Title:

Healthy and sustainable diets: community concern about the effect of the future food environments and support for government regulating sustainable food supplies in Western Australia.

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Abstract

Objective: To determine the level of community concern about future food supplies and perception of the importance placed on government regulation over the supply of environmentally friendly food and identify dietary and other factors associated with these beliefs in Western Australia.

Design: Data from the 2009 and 2012 Nutrition Monitoring Survey Series computer-assisted telephone interviews were pooled. Level of concern about the effect of the environment on future food supplies and importance of government regulating the supply of environmentally friendly food were measured. Multivariate regression analysed potential associations with sociodemographic variables, dietary health consciousness, weight status and self-reported intake of eight foods consistent with a sustainable diet.

Setting: Western Australia.

Subjects: Community-dwelling adults aged 18 to 64 years (*n*=2,832).

Results: Seventy nine per cent of Western Australians were 'quite' or 'very' concerned about the effect of the environment on future food supplies. Respondents who paid less attention to the health aspects of their diet were less likely than those who were health conscious ('quite' or 'very' concerned) (OR= 0.53, 95% CI [0.35, 0.8] and 0.38 [0.17, 0.81] respectively). The majority of respondents (85.3%) thought it was 'quite' or 'very' important that government had regulatory control over an environmentally friendly food supply. Females were more likely than males to rate regulatory control as 'quite' or 'very' important' (OR= 1.63, 95% CI [1.09, 2.44], *p* = .02). Multiple regression modeling found that no other factors predicted concern or importance.

Conclusions: There is a high level of community concern about the impact of the environment on future food supplies and most people believe it is important that the government regulates the issue. These attitudes dominate regardless of sociodemographic characteristics, weight status or sustainable dietary behaviours.

Introduction

Diet-related chronic diseases, such as coronary heart disease, are the leading causes of preventable death in Australia and many other Western countries (Australian Institute of Health and Welfare, 2015; World Health Organization, 2014). The economic burden on Australia's health system attributed to diet-related diseases is significant, with overweight and obesity costing approximately AUD $21 billion annually (Colagiuri et al., 2010). Yet, the current neo-liberal Western Australian political environment, with deregulation a priority, means making regulatory changes to better control and improve the food supply is challenging (Pollard, Daly, Moore, & Binns, 2013).

A sustainable food supply is essential to ensure adequate nutritious food for current and future generations. Despite challenging environmental conditions at times, for example due to hot conditions and drought, Australia is food secure and continues to attract a strong global demand for food exporting AUD$31.8 billion and importing only AUD$11.6 billion in 2012-13 (Department of Agriculture, 2014). Western Australia exports approximately 80% of its agricultural production, prominently grains and cereals, meat (including live animal exports), dairy foods, fruits and vegetables, and processed foods (Department of Primary Industries and Regional Development, 2017). It has been suggested that the increasing pressure on farmers operating in this neo-liberal environment limits Australia's capacity to maintain current food production, food security and exports into the future (Lawrence, Richards, & Lyons, 2013). The relevance of the food supply and environmental sustainability to public health is not a new issue (Gussow & Clancy, 1986), yet it is complex, and often contested. There is increasing evidence that choosing foods consistent with dietary guidelines will likely result in a lower environmental impact (Nelson, Hamm, Hu, Abrams, & Griffin, 2016). Considerations of sustainable diets, that in addition to being healthy also protect the environment to ensure the future of a safe, adequate, and nutritious food supply, are increasing in Australia (Bradbear & Friel, 2011, 2013; Friel, Barosh, & Lawrence, 2014) and internationally (Burlingame & Dernini, 2012; Watts et al., 2015). The current EATLancet Commission on Food, Planet and Health (Rockström, Stordalen, & Horton, 2016) aims to build the evidence for healthy and sustainable dietary recommendations while countries like Sweden have already adopted sustainable diet recommendations into their national dietary guidelines (Livsmedelsverket National Food Agency Sweden, 2015) and America has placed greater emphasis on healthy and sustainable food choices (U.S. Department of Health and Human Services and U.S. Department of Agriculture, 2015). Australian Dietary Guidelines have included special considerations of the sustainability of food systems over the last three decades, incorporated as separate evidence chapters (National Health and Medical Research Council, 2003). The most recent revision in 2013 proposed a specific guideline advising Australians to eat for environmental sustainability and health; however, this

guideline was highly contested by industry and did not eventuate. Instead an appendix on food, nutrition and environmental sustainability containing practical tips for minimising the environmental impact of dietary choices as well as promoting health through reducing food and packaging waste, not consuming excess kilojoules and choosing fruits and vegetables in season was included (National Health and Medical Research Council, 2013).

A sustainable diet is defined as being healthy and safe, but with greater complexity and dependence on several factors including food access and availability, geographical location and agricultural practices (Burlingame & Dernini, 2012). It is widely accepted that the consumption of excess kilojoules, most of which are highly processed and packaged energy-dense nutrient-poor foods in Australia, creates an avoidable environmental burden and contributes to overweight and obesity (Bradbear & Friel, 2011; Larsen, Ryan, & Abraham, 2008; National Health and Medical Research Council, 2013; Riley & Buttriss, 2011) . There is increasing evidence supporting the greater environmental impact of meat and dairy foods compared to plant-based foods, regardless of potentially high nutrient values (Bradbear & Friel, 2011; Macdiarmid et al., 2012; Reynolds, Buckley, Weinstein, & Boland, 2014; Springmann, Godfray, Rayner, & Scarborough, 2016). The general public however, differ in their understanding of the potential impact of dietary practices on the environment. An Australian study found that people believed food packaging has a greater impact on the environment than the consumption of meat (Lea & Worsley, 2008). Data shows that this is often not the case with agricultural and farming practices placing greater pressure on biodiversity than resources used in developing and disposing of food packaging (Bradbear & Friel, 2011). A UK study found that although awareness of the impact of meat on environmental sustainability was high, human health and animal welfare were greater motivators to reduce meat intake than environmental sustainability (Clonan, Wilson, Swift, Leibovici, & Holdsworth, 2015).

Government food policy and regulation aims to protect public health and safety by shaping the food supply, from production through to marketing and promotion through standards and controls (Joint FAO/WHO Codex Alimentarius Commission, 2016; Thow, Jan, Leeder, & Swinburn, 2010). The Australian Policy Cycle highlights the importance of stakeholder consultations, including considerations of consumer attitudes, concerns and support for policy options in policy and regular decision making (Bridgman & Davis, 2004). Consumer concerns are considered during the policy initiation and development process, as is the potential impact of policy or regulatory controls on food choices, dietary patterns and health. Yet, little is known of public concern about a sustainable food supply in Australia or whether there is support for tighter government control. Effective policy

action needs to be informed by an understanding of consumer concerns regarding the issue, motivations for change and support for policy options. There is a policy interest in consumer information to support the coupling of healthy and sustainable dietary advice, and inform potential actions to protect the food supply. In Australia, there is little, if any, population-based evidence on people's perceptions about environmentally friendly food and how, or if, these attitudes translate to food choices.

The Department of Health in Western Australia's triennial Nutrition Monitoring Survey Series (NMSS) investigates consumer attitudes, knowledge and behaviours related to the Australian Dietary Guidelines (Pollard, Harray, Daly, & Kerr, 2015). The objectives of this study were to determine the level of community concern about impacts on future food supplies and the perception of the importance placed on government regulation over the supply of environmentally friendly food, and identify dietary and other factors associated with the these beliefs.

Methods

Sample

Data from the NMSS 2009 and 2012 computer-assisted telephone interviews of a representative sample of Western Australian adults, aged 18 to 64 years, were pooled for analysis. Informed consent was obtained from all respondents. A full explanation of the survey methodology is described elsewhere (Pollard, Harray, et al., 2015; Rockström et al.). In brief, sample selection involved a stratified random sample extracted from the electronic White Pages for Western Australia by area of residence. If more than one adult in a household met the inclusion criteria, the person with the most recent birthday was selected to participate in the survey. The response rate (completed/contacted) was 81.6% and 82.4% for 2009 and 2012, respectively (Pollard, McStay, & Meng, 2015).

Measures

The two main outcome measures in this study were concern about the environmental impact on future food supplies and importance of government regulation over an environmentally friendly food supply, measured using two single response questions:

1) How important would you say it is that the government has control over or regulates the supply of environmentally friendly food? *Single response options:* Not at all important; not very important; neither important nor unimportant; quite important; or very important.

2) How concerned would you say you are about the effect of the environment on the future of food supplies? *Single response options:* Not very concerned; somewhat concerned; neither unconcerned nor concerned; quite concerned; or very concerned.

Factors potentially associated with dietary attitudes and behaviours included: sociodemographic variables (age, sex, education, employment, household income, area of residence, country of birth); weight status based on self-reported height and weight categorised into Body Mass Index (with a factor applied to correct for under-reporting of weight and over-reporting of height (Hayes, Kortt, Clarke, & Brandrup, 2008); dietary health consciousness, current eating behaviours relating to a sustainable diet (based on self-reported intake of fruits, vegetables, vegetable variety, red meat, fish, dairy foods, bottled water, sugar-sweetened and diet/intense sweetened beverages on the day prior to the survey).

The eight self-reported dietary intake questions were chosen to reflect compliance with a healthy *and* sustainable diet (Harray et al., 2015). Categorical cut-offs were set for the amounts of each of these food groups eaten on the day prior to reflect sustainable eating behaviours consistent with the Australian food selection guide daily intake recommendations (Australian Guide to Healthy Eating) (National Health and Medical Research Council, 2013) and consumption levels as determined by the NMSS (Pollard, Harray, et al., 2015): meat (above or below one standard 65 gram serving of cooked red meat); vegetables (median ≤ or > two 75 gram servings); and sugar sweetened or diet/intense sweetened beverages (consumer or non-consumer). The authors determined the cut-offs, for example, for vegetables, the cut-off of two or less servings per day was chosen rather than the aspirational recommendation of five or more servings per day, because the median consumption was three servings per day and it was hypothesised that the sample size at the two serving cut-off would enable the potential to detect those respondents who were likely to eat a more healthful diet, as well as consider sustainable dietary practices. The categorisation of non-consumer versus consumer for sugar-sweetened beverages, diet beverages, and bottled water as unsupportive of a sustainable diet, were based on the beverage's energy contribution and/or their levels of processing, packaging and contributing to landfill.

Dietary health consciousness was determined by asking, "Which of the following best describes how you feel about your diet?" *Single response options*: "pay a lot of attention to the health aspects of the food I eat"; "take a bit of notice of the health aspects of the food I eat"; or "don't think much about the health aspects of the food I eat".

Statistical analysis

Data were pooled and weighted to account for sample design and post adjusted for age, sex and geographic area of 2011 Estimated Resident Population of Western Australia. Body Mass Index (BMI) was calculated from self-reported height and weight, adjusted to account for possible reporting bias prior to calculation of BMI (Hayes et al., 2008).

Descriptive statistics report the prevalence of attitudes regarding the effect of environment on future of food supply and government control or regulation of environmental friendly food. Binary logistic regression was used to explore factors associated with respondents' concern regarding the effect of environment on future food supplies [low level of concern included 'not very, somewhat and neither' versus 'quite and very' concerned] and attitude toward government regulation of an environmentally friendly food supply ['not at all, not very important and neither' versus 'quite and very' important). The full model includes variables that have a p value < .20 in a univariate analysis. Both backward elimination and forward selection manner were used in the model building process and only variables with a p value < .05 retained in the final model and reported. Survey module of Stata software version 12.0 (StataCorp LP, College Station, TX) was used for all analyses.

Results

The characteristics of the survey population are shown in Table 1. Table 2 shows the overall concern for the effect of the environment on future food supplies was high and increasing, with 78.6% of all respondents rating themselves as 'quite' or 'very' concerned. The proportion who were 'very' concerned was significantly higher; in 2012 than in 2009 (p = .001), in females than males (p < .001), in those aged 35 years and older (p < .001), in fruit consumers compared to those who did not eat fruit the day prior (p = .004), and in those who paid a lot of attention to the health aspects of their diet (p < .001). The full binary logistic regression model found that dietary health consciousness was the only variable associated with concern about the effect of the environment on future food supplies. Compared to those who paid 'a lot of attention', respondents who said they 'take a bit of notice' or 'don't really think about it' were less likely to be 'quite' or 'very' (OR= 0.53, 95% CI [0.35, 0.8] and 0.38 [0.17, 0.81] respectively, all p < .05), not shown.

168 **Table 1. Sample demographics, attitudes and weight status, Nutrition Monitoring Survey**
169 **Series, Western Australia 2009 & 2012.**

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Characteristic		2009 (*n* = 1284)	2012 (*n* = 1548)	Total % [a] (*n* = 2832)
Sex	Female	830	1,005	49.8
	Male	454	543	50.2
Age	18-34 years	251	210	38.1
	35-44 years	340	377	22.7
	45-54 years	356	466	21.6
	55-64 years	337	495	17.7
Area of residence	Metropolitan	965	1,011	79.3
	Remote areas	29	82	3.6
	Rural areas	290	455	17.1
Education	Less than high school	221	211	10.8
	High school	178	198	16.7
	Trade/Certificate/Diploma	481	632	37.8
	University degree	399	504	34.5
	Missing	5	3	0.2
Household income ($AUD)	Up to $60,000	349	346	19.7
	$60,001-$140,000	619	754	49.3
	Over $140,000	195	270	18.4
	Don't know/unsure/refused	121	178	12.6
Employment status	Currently not in paid employment	364	408	27.9
	Currently in paid employment	920	1,139	72.1
	Missing	0	1	0
Country of birth	Australia	867	1,122	69.3
	UK/Ireland	202	221	12.7
	Other countries	214	205	17.9
	Missing	1	0	0
BMI (kg/m^2)	Underweight (<18.5)	1.2	1.2	1.2
	Normal weight (18.5–24.9)	35.3	33.8	34.5
	Overweight (≥25-29.9)	37.5	36.9	37.2
	Obese (≥30)	20.9	23.7	22.3
	Not provided	5.2	4.5	4.8
Dietary health consciousness	Pay a lot of attention	43.2	41.9	42.5
	Take a bit of notice	50.0	50.2	50.1
	Don't think much	6.8	7.7	7.3

Percentages were weighted for probability of selection and adjusted by age, sex and geographic area to the 2011 Estimated Resident Population of Western Australia

Table 2. Concern about the effect of the environment on future food supplies by sociodemographic variables, behaviours, attitudes and weight status, Nutrition Monitoring Survey Series, Western Australia, 2009 & 2012 combined.

		n	Not very % [95% CI]	Somewhat % [95% CI]	Neither % [95% CI]	Quite % [95% CI]	Very % [95% CI]	*p* value
Year	2009	1265	9.1 [6.8 - 12.0]	9.7 [7.8 - 12.0]	4.4 [3.2 - 5.9]	29.4 [26.2 - 32.8]	47.5 [44.0 - 51.0]	.001
	2012	897	6.0 [4.4 - 8.2]	8.0 [5.6 - 11.2]	4.1 [2.6 - 6.5]	21.8 [18.1 - 26.1]	60.0 [55.4 - 64.6]	
Sex	Female	1423	5.5 [4.1 - 7.2]	9.0 [7.0 - 11.6]	3.5 [2.5 - 4.9]	24.2 [21.3 - 27.4]	57.7 [54.2 - 61.2]	.001
	Males	739	10.5 [7.6 - 14.3]	9.2 [7.0 - 11.9]	5.1 [3.5 - 7.2]	29.2 [25.2 - 33.5]	46.1 [41.7 - 50.6]	
	Persons	2162	8.0 [6.3 - 10.0]	9.1 [7.6 - 10.9]	4.3 [3.3 - 5.5]	26.7 [24.2 - 29.3]	51.9 [49.1 - 54.7]	
Age	18-34 years	373	10.8 [7.2 - 15.7]	9.9 [6.9 - 13.9]	5.2 [3.4 - 8.0]	31.0 [25.8 - 36.8]	43.2 [37.4 - 49.1]	< .001
	35-44 years	569	6.8 [4.6 - 10.1]	10.5 [7.7 - 14.2]	3.5 [2.0 - 6.0]	24.7 [20.6 - 29.2]	54.5 [49.5 - 59.4]	
	45-54 years	622	7.0 [4.7 - 10.3]	7.5 [5.3 - 10.5]	2.8 [1.7 - 4.7]	24.0 [20.2 - 28.2]	58.6 [53.8 - 63.3]	
	55-64 years	598	4.7 [3.0 - 7.3]	7.6 [5.4 - 10.5]	5.2 [3.4 - 7.8]	23.3 [19.7 - 27.4]	59.2 [54.6 - 63.7]	
Area of residence	Metropolitan	1341	8.0 [6.0 - 10.6]	8.9 [7.1 - 11.1]	4.2 [3.1 - 5.6]	26.7 [23.8 - 29.9]	52.2 [48.8 - 55.5]	.97
	Rest of state	821	7.9 [6.0 - 10.3]	9.8 [7.3 - 13.0]	4.7 [3.0 - 7.3]	26.7 [22.9 - 30.8]	50.9 [46.5 - 55.4]	
Country of birth	Australia	1536	7.3 [5.6 - 9.5]	10.1 [8.1 - 12.4]	4.4 [3.3 - 6.0]	26.1 [23.2 - 29.3]	52.0 [48.6 - 55.4]	.39
	Outside of Australia	625	9.4 [6.2 - 14.1]	7.1 [4.9 - 10.2]	3.8 [2.4 - 5.9]	28.0 [23.4 - 33.0]	51.7 [46.5 - 56.9]	
Highest education	Less than year 12	346	3.4 [1.5 - 7.4]	9.2 [5.5 - 15.1]	5.1 [2.6 - 9.8]	25.2 [20.1 - 31.1]	57.0 [50.2 - 63.6]	.15
	Year 12	285	9.3 [4.5 - 18.4]	11.5 [7.7 - 16.9]	3.3 [1.6 - 6.9]	30.1 [23.1 - 38.0]	45.7 [38.0 - 53.7]	
	TAFE/Trade/ Diploma	862	8.5 [6.1 - 11.6]	9.6 [7.0 - 12.9]	4.8 [3.3 - 6.9]	22.0 [18.6 - 25.9]	55.1 [50.6 - 59.4]	
	Tertiary	662	8.3 [5.7 - 11.9]	7.2 [5.1 - 10.2]	4.0 [2.4 - 6.4]	30.7 [26.2 - 35.7]	49.8 [44.7 - 54.8]	
Employment status	Currently in paid employment	1574	9.4 [5.9 - 14.7]	9.2 [6.5 - 12.9]	3.5 [2.1 - 5.7]	25.3 [20.5 - 30.7]	52.6 [46.9 - 58.2]	.70
	Currently not in paid employment	588	7.4 [5.7 - 9.5]	9.1 [7.3 - 11.2]	4.6 [3.5 - 6.2]	27.3 [24.4 - 30.3]	51.6 [48.4 - 54.8]	
Household income ($AUD)	Up to $60,000	558	8.3 [4.5 - 14.8]	8.6 [5.3 - 13.7]	3.7 [2.0 - 6.8]	23.8 [18.8 - 29.6]	55.7 [49.2 - 61.9]	.45
	$60,001-$140,000	1061	6.9 [5.0 - 9.4]	9.1 [7.2 - 11.5]	3.9 [2.7 - 5.6]	28.4 [25.0 - 32.1]	51.7 [47.8 - 55.6]	
	Above $140,000	327	9.0 [5.4 - 14.6]	8.1 [5.1 - 12.8]	3.6 [1.8 - 7.1]	30.2 [24.1 - 37.1]	49.0 [42.4 - 55.7]	
	Don't know/unsure/missing	216	10.6 [5.7 - 18.8]	11.3 [6.7 - 18.6]	7.9 [4.6 - 13.1]	20.3 [13.7 - 29.0]	50.0 [40.8 - 59.2]	
Self-reported dietary intake on day prior to survey								
Fruit	Non-consumer (14%)	311	14.5 [8.9 - 22.5]	8.0 [4.9 - 12.8]	6.0 [3.5 - 10.4]	28.9 [22.6 - 36.1]	42.6 [35.5 - 50.0]	.004
	Consumer (86%)	1845	6.8 [5.2 - 8.7]	9.3 [7.6 - 11.3]	3.9 [2.9 - 5.2]	26.3 [23.6 - 29.2]	53.7 [50.6 - 56.8]	
Vegetables	≤ 2 serves (43%)	921	10.5 [7.6 - 14.4]	9.5 [7.3 - 12.3]	5.2 [3.6 - 7.4]	24.5 [21.0 - 28.5]	50.2 [45.9 - 54.6]	.28
	> 2 serves (57%)	1217	5.9 [4.2 - 8.2]	8.7 [6.6 - 11.3]	3.6 [2.5 - 5.1]	28.1 [24.7 - 31.7]	53.8 [49.9 - 57.6]	
Vegetable variety	≤ 3 types	885	10.2 [7.3 – 14.1]	8.9 [6.7 – 11.7]	4.8 [3.3 – 6.8]	26.9 [23.0 – 31.1]	49.3 [44.8 – 53.7]	.11
	> 3 types	1264	6.1 [4.5 – 8.2]	9.4 [7.4 – 12.0]	3.9 [2.7 – 5.6]	26.4 [23.3 – 29.8]	54.1 [50.4 – 57.8]	
Meat (2012 only)	≤ 1 serve (86%)	768	5.3 [3.4 - 8.1]	7.5 [5.1 - 10.8]	4.3 [2.3 - 7.8]	20.6 [16.2 - 25.8]	62.4 [56.7 - 67.7]	.33
	> 1 serve (14%)	129	3.6 [1.4 - 8.7]	12.0 [4.5 - 28.3]	4.0 [1.5 - 10.2]	30.1 [17.9 - 45.8]	50.3 [36.3 - 64.3]	
Fish (2012 only)	≤ 1 serve (94%)	844	4.1 [2.8 - 6.0]	8.9 [6.0 - 12.9]	4.4 [2.5 - 7.5]	22.1 [17.6 - 27.3]	60.5 [54.8 - 65.9]	.08
	> 1 serve (6%)	53	14.9 [4.7 - 38.0]	1.5 [0.5 - 5.0]	2.3 [0.4 - 12.4]	24.7 [9.6 - 50.4]	56.6 [34.8 - 76.1]	
Dairy foods	≤ 2 serves (55%)	1192	9.2 [6.8 – 12.4]	8.4 [6.5 – 10.7]	4.3 [3.0 – 6.0]	27.3 [24.1 – 30.9]	50.8 [47.0 – 54.6]	.40
	> 2 serves (45%)	970	6.5 [4.5 – 9.1]	10.0 [7.6 – 13.1]	4.3 [3.0 – 6.3]	25.9 [22.3 – 30.0]	53.2 [49.0 – 57.5]	
Soft and diet drinks	Non-consumer (70%)	1520	10.2 [7.3 - 14.2]	10.2 [7.3 - 14.1]	3.9 [2.4 - 6.4]	25.8 [21.6 - 30.4]	49.9 [44.8 - 54.9]	.31
	Consumer (30%)	642	6.9 [5.0 - 9.4]	8.6 [6.9 - 10.6]	4.5 [3.3 - 6.0]	27.2 [24.2 - 30.4]	52.9 [49.5 - 56.3]	

Bottled water	Non-consumer (80%)	1607	3.8 [2.0 - 6.9]	9.2 [5.5 - 14.9]	5.5 [3.1 - 9.3]	27.7 [22.2 - 34.0]	53.9 [47.5 - 60.2]	.17
	Consumer (20%)	399	8.6 [6.6 - 11.1]	9.1 [7.4 - 11.1]	3.9 [2.8 - 5.2]	25.8 [23.0 - 28.9]	52.6 [49.3 - 55.9]	
Dietary health consciousness	Pay a lot of attention	1062	4.6 [3.2 - 6.5]	7.0 [5.2 - 9.4]	3.7 [2.5 - 5.5]	25.8 [22.4 - 29.6]	58.9 [54.8 - 62.8]	< .001
	Take a bit of notice	985	9.8 [7.1 - 13.3]	10.8 [8.4 - 13.9]	4.7 [3.3 - 6.6]	28.3 [24.6 - 32.3]	46.4 [42.3 - 50.6]	
	Don't think about it	115	16.2 [8.4 - 28.7]	9.7 [4.9 - 18.3]	5.2 [2.2 - 12.1]	21.2 [12.9 - 32.8]	47.7 [35.7 - 59.9]	
BMI (kg/m^2)	Healthy weight (<25)	657	6.6 [3.8 - 11.3]	10.5 [7.5 - 14.5]	4.8 [3.2 - 7.0]	27.1 [22.4 - 32.2]	51.1 [45.7 - 56.5]	.75
	Overweight (≥25-29.9)	833	9.4 [7.0 - 12.6]	8.0 [6.0 - 10.5]	4.1 [2.6 - 6.4]	26.6 [22.9 - 30.6]	52.0 [47.7 - 56.2]	
	Obese (≥30)	549	7.2 [4.8 - 10.7]	8.3 [5.7 - 11.9]	4.4 [2.6 - 7.1]	25.0 [20.5 - 30.1]	55.2 [49.8 - 60.5]	

Estimates were weighted for probability of selection and adjusted by age, sex and geographic area to the 2011 Estimated Resident Population of Western Australia. *p* values were derived from design-based Pearson chi-square test.

Table 3 shows the majority of respondents in both 2009 and 2012 believed it was 'quite' or 'very' important for the government to control or regulate an environmentally friendly food supply, 84.6% and 86.0%, respectively. There was a significant difference in the proportion of respondents who reported being 'quite' or 'very' important in 2012 ($p = .04$), but not in 2009. Females were more likely to rate this issue as 'very' important than males ($p < .001$). Over half (52.1%) of respondents with a household income below AUD$60,000 per annum rated government control as 'very' important compared with only 36.2% of households with an income above AUD$140,000 ($p = .002$). Those living in Western Australia's capital city, Perth, were significantly more likely to rate government regulation as 'quite' or 'very' important, compared with those living in the rest of the state ($p = .01$). Respondents classified as having a healthy body weight or less (BMI < 25kg/m^2) were more likely to rate regulation as 'quite' important than those who were classified as overweight or obese ($p < .001$). Binary logistic regression modeling revealed females were more likely than males to believe government regulation was 'quite/very' important (OR=1.63, 95% CI [1.09, 2.44], $p = .02$), not shown.

To test the relationship between the two questions of interest, the 'level of concern' variable was added to the multivariable logistic regression model. Level of concern remained significant independent of gender (overall p<0.001, and p=0.01 and p<0.001 for those 'quite' and 'very' concerned respectively). These results show that respondents who were concerned about the effect of the environment on future food supplies are more likely to want more government control over the issue.

Table 3. Importance placed on government control or regulation of an environmentally friendly food supply by sociodemographic variables, behaviours, attitudes and weight status, Nutrition Monitoring Survey Series, Western Australia, 2009 & 2012 (n=2142).

		n	Not at all % [95% CI]	Not very % [95% CI]	Neither % [95% CI]	Quite % [95% CI]	Very % [95% CI]	*p* value
Year	2009	1255	3.1 [2.2 - 4.3]	7.2 [5.4 - 9.5]	5.1 [3.8 - 6.7]	39.6 [36.1 - 43.3]	45.0 [41.5 - 48.6]	.04
	2012	887	4.4 [2.8 - 6.8]	3.9 [2.7 - 5.8]	5.6 [4.0 - 7.8]	36.3 [32.0 - 40.9]	49.7 [45.1 - 54.4]	
Sex	Female	1411	1.7 [1.1 - 2.5]	4.2 [3.1 - 5.7]	5.9 [4.6 - 7.6]	37.6 [34.2 - 41.1]	50.6 [47.1 - 54.1]	< .001
	Males	731	5.4 [3.9 - 7.4]	7.9 [5.7 - 10.8]	4.6 [3.2 - 6.6]	39.3 [35.0 - 43.8]	42.8 [38.4 - 47.3]	
	Persons	2142	3.5 [2.7 - 4.6]	6.1 [4.8 - 7.6]	5.3 [4.2 - 6.5]	38.5 [35.7 - 41.3]	46.7 [43.8 - 49.5]	
Age (years)	18-34	374	2.0 [0.9 - 4.1]	7.0 [4.5 - 10.7]	5.1 [3.3 - 7.9]	44.3 [38.5 - 50.2]	41.6 [35.9 - 47.6]	.005
	35-44	559	3.1 [1.7 - 5.4]	5.1 [3.2 - 8.1]	4.8 [3.2 - 7.1]	36.4 [31.6 - 41.5]	50.6 [45.6 - 55.6]	
	45-54	618	4.6 [2.9 - 7.4]	5.0 [3.4 - 7.4]	5.8 [4.0 - 8.3]	37.4 [32.8 - 42.2]	47.2 [42.4 - 52.0]	
	55-64	591	6.2 [4.3 - 9.0]	6.6 [4.5 - 9.6]	5.4 [3.7 - 8.0]	29.9 [25.9 - 34.3]	51.8 [47.1 - 56.5]	
Area of residence	Metropolitan	1328	3.5 [2.5 - 4.8]	6.2 [4.7 - 8.2]	4.4 [3.3 - 5.8]	38.7 [35.4 - 42.1]	47.3 [43.9 - 50.7]	.01
	Rest of state	814	3.9 [2.6 - 5.6]	5.5 [4.0 - 7.6]	8.6 [6.2 - 11.9]	37.6 [33.4 - 42.0]	44.4 [40.3 - 48.6]	
Country of birth	Australia	1526	3.9 [2.9 - 5.3]	6.5 [5.0 - 8.5]	5.9 [4.6 - 7.4]	38.0 [34.7 - 41.4]	45.7 [42.3 - 49.1]	.35
	Outside of Australia	616	2.7 [1.6 - 4.8]	5.1 [3.2 - 8.1]	3.9 [2.4 - 6.4]	39.5 [34.4 - 44.8]	48.7 [43.5 - 54.0]	
Highest education	Less than year 12	347	4.2 [2.4 - 7.5]	4.9 [2.4 - 9.7]	4.9 [3.1 - 7.7]	33.5 [27.4 - 40.2]	52.4 [45.7 - 59.0]	.24
	Year 12	286	2.3 [1.0 - 5.6]	8.1 [4.6 - 13.9]	6.2 [3.6 - 10.4]	39.0 [31.2 - 47.4]	44.4 [36.7 - 52.3]	
	TAFE/Trade/ Diploma	846	2.9 [1.8 - 4.6]	4.0 [2.8 - 5.9]	5.8 [4.0 - 8.2]	39.6 [35.3 - 44.0]	47.8 [43.4 - 52.2]	
	Tertiary	658	4.7 [3.1 - 7.0]	7.7 [5.3 - 11.0]	4.4 [3.0 - 6.3]	38.8 [34.0 - 43.8]	44.5 [39.4 - 49.6]	
Employment status	Currently in paid employment	1563	1.9 [1.0 - 3.4]	6.7 [4.4 - 10.3]	4.6 [3.0 - 7.0]	42.5 [36.7 - 48.4]	44.3 [38.7 - 50.0]	.11
	Currently not in paid employment	579	4.2 [3.2 - 5.6]	5.8 [4.4 - 7.6]	5.5 [4.3 - 7.0]	36.9 [33.8 - 40.1]	47.6 [44.3 - 50.9]	
Household income ($AUD)	Up to $60,000	549	2.8 [1.7 - 4.7]	3.8 [2.1 - 6.6]	5.9 [3.8 - 9.1]	35.4 [29.3 - 42.0]	52.1 [45.7 - 58.5]	.002
	$60,001-$140,000	1058	3.4 [2.3 - 4.9]	5.6 [4.0 - 8.0]	4.5 [3.2 - 6.3]	37.4 [33.7 - 41.2]	49.1 [45.2 - 53.1]	
	Above $140,000	325	5.3 [3.0 - 9.3]	11.9 [7.8 - 17.9]	5.1 [3.2 - 8.2]	41.5 [34.8 - 48.4]	36.2 [30.2 - 42.6]	
	Don't know/unsure/missing	210	3.1 [1.2 - 8.2]	3.8 [2.0 - 7.1]	7.4 [4.4 - 12.2]	44.5 [35.2 - 54.1]	41.2 [32.4 - 50.5]	
Self-reported dietary intake on day prior to survey								
Fruit	Non-consumer (15%)	312	3.3 [1.7 - 6.1]	8.3 [4.6 - 14.5]	5.8 [3.4 - 9.6]	35.8 [28.8 - 43.5]	46.8 [39.3 - 54.4]	.66
	Consumer (85%)	1823	3.6 [2.7 - 4.8]	5.7 [4.4 - 7.3]	5.2 [4.1 - 6.5]	38.7 [35.7 - 41.8]	46.9 [43.8 - 50.0]	
Vegetables	≤ 2 serves (43%)	910	3.5 [2.4 - 5.1]	6.8 [4.8 - 9.5]	5.5 [3.9 - 7.8]	39.6 [35.4 - 43.9]	44.7 [40.4 - 49.0]	.77
	> 2 serves (57%)	1210	3.7 [2.5 - 5.3]	5.6 [4.0 - 7.6]	5.0 [3.8 - 6.5]	37.9 [34.2 - 41.8]	47.9 [44.1 - 51.7]	
Vegetable variety	≤ 3 types (41%)	876	2.1 [1.2 – 3.6]	7.2 [5.1 – 10.1]	4.5 [3.1 – 6.5]	40.1 [35.7 – 44.6]	46.1 [41.7 – 50.6]	.02
	> 3 types (59%)	1252	4.8 [3.6 – 6.5]	5.0 [3.7 – 6.8]	6.0 [4.6 – 7.7]	36.9 [33.4 – 40.5]	47.3 [43.7 – 51.0]	
Meat (2012 only)	≤ 1 serve (85%)	756	4.7 [2.6 - 8.2]	2.9 [1.8 - 4.6]	5.5 [3.8 - 8.0]	37.4 [32.0 - 43.1]	49.5 [43.9 - 55.2]	.47
	> 1 serve (15%)	131	4.1 [1.4 - 11.8]	7.3 [2.7 - 18.2]	3.5 [1.4 - 8.7]	38.5 [25.5 - 53.3]	46.6 [32.8 - 60.9]	
Fish (2012 only)	≤ 1 serve (94%)	834	4.2 [2.5 - 7.0]	3.7 [2.3 - 6.1]	5.3 [3.6 - 7.6]	37.0 [31.6 - 42.6]	49.9 [44.4 - 55.4]	.64
	> 1 serve (6%)	53	8.9 [1.5 - 38.1]	3.3 [0.6 - 16.3]	3.7 [1.0 - 12.5]	45.1 [25.7 - 66.1]	38.9 [21.2 - 60.1]	
Dairy foods	≤ 2 serves (55%)	1186	3.3 [2.3 – 4.8]	6.2 [4.5 – 8.4]	5.2 [3.9 – 6.9]	40.0 [36.2 – 43.9]	45.3 [41.5 – 49.2]	.78
	> 2 serves (45%)	956	3.8 [2.6 – 5.6]	5.9 [4.1 – 8.5]	5.3 [3.8 – 7.3]	36.6 [32.5 – 40.9]	48.3 [44.1 – 52.6]	
Soft and diet drinks	Non-consumer (70%)	1510	4.2 [2.7 - 6.4]	4.8 [2.8 - 8.0]	4.5 [3.0 - 6.8]	36.3 [31.6 - 41.3]	50.2 [45.2 - 55.3]	.27

	Consumer (30%)	632	3.3 [2.3 - 4.5]	6.7 [5.2 - 8.6]	5.6 [4.3 - 7.2]	39.5 [36.2 - 43.0]	44.9 [41.6 - 48.3]	
Bottled water	Non-consumer (80%)	1592	1.7 [0.8 - 3.5]	8.5 [5.3 - 13.4]	5.2 [3.3 - 8.2]	36.9 [30.9 - 43.4]	47.7 [41.4 - 54.0]	.17
	Consumer (20%)	396	3.9 [2.9 - 5.3]	5.5 [4.2 - 7.2]	5.1 [3.9 - 6.6]	39.0 [35.8 - 42.3]	46.5 [43.2 - 49.8]	
Dietary health consciousness	Pay a lot of attention	1051	4.0 [2.7 - 5.9]	5.9 [4.2 - 8.4]	4.1 [2.9 - 5.7]	34.8 [31.0 - 38.7]	51.2 [47.1 - 55.2]	.046
	Take a bit of notice	978	3.2 [2.2 - 4.8]	6.0 [4.4 - 8.2]	5.4 [3.9 - 7.3]	42.4 [38.2 - 46.7]	43.0 [38.9 - 47.2]	
	Don’t think much	113	2.8 [1.2 - 6.5]	7.0 [2.2 - 20.2]	11.6 [6.2 - 20.6]	34.0 [23.7 - 46.1]	44.6 [32.9 - 57.0]	
BMI (kg/m^2)	Healthy weight or less (<25)	651	0.8 [0.4 - 1.7]	6.3 [4.1 - 9.6]	4.6 [3.1 - 6.7]	42.2 [36.9 - 47.7]	46.2 [40.8 - 51.6]	< .001
	Overweight (25-29.9)	821	5.9 [4.1 - 8.4]	6.7 [4.8 - 9.5]	5.2 [3.7 - 7.3]	35.0 [30.9 - 39.3]	47.2 [43.0 - 51.6]	
	Obese (≥30)	546	3.9 [2.6 - 5.9]	4.3 [2.6 - 6.8]	6.8 [4.5 - 10.3]	38.9 [33.8 - 44.3]	46.1 [40.9 - 51.4]	

Estimates were weighted for probability of selection and adjusted by age, sex and geographic area to the 2011 Estimated Resident Population of Western Australia. *p* values were derived from design-based Pearson chi-square test.

Discussion

This study aimed to determine factors associated with Western Australian adults' concern about future food supplies and importance placed on regulation of environmentally friendly food. The results indicate a high and increasing concern across the population about the impact of the environment on future food supplies, and a high level of importance placed on government regulating the supply of foods to support the environment.

Dietary health consciousness was the only factor associated with concern about the effect of the environment on future food supplies when factors such as body weight, sociodemographic characteristics and current dietary behaviours were taken into account. Respondents with low levels of dietary health consciousness were a third less likely than those paying a lot of attention to be very concerned about the effect of the environment on future food supplies. It is possible that dietary health consciousness reflects a general broad concern about food and health, including consideration of the source of food. Further research is needed to identify the drivers of and barriers to higher levels of dietary health consciousness.

Previous studies have found that those with a high level of concern about the environment were likely consumers of diets high in fruit (Reynolds et al., 2014) and this was consistent with the current study findings. Diets high in fruit and vegetables, low in added sugar and fast food are associated with the importance placed on sustainable food production practices (Pelletier, Laska, Neumark-Sztainer, & Story, 2013). The current study found a high level of community support for government involvement in the regulation of an environmentally sustainable food supply in Western Australia. Regulatory options that could reduce the impact of the food supply on the environment include taxes on landfill, tightening trade laws, farming practices and food production methods. Governments could also regulate for carbon footprint levels on packaged food labels to assist consumers to make environmentally friendly food choices at the point of food selection (Lang, Barling, & Caraher, 2009).

Most of Australia's population does not adhere to dietary recommendations, for example, in 2011/12 only seven per cent ate the recommended two servings of fruit and five servings of vegetables per day (Australian Bureau of Statistics, 2014). This is despite the effort of health promotion campaigns between 2001 and 2005, which aimed to increase consumption of fruit and vegetables (Pollard et al., 2008). Such campaigns focused on the health benefits and ease of increasing a serving of vegetables and resulted in increased population intake at the time of

delivery. The current study findings suggest that a message regarding both a healthy *and* sustainable food choices may resonate with the Western Australian community.

The results from this study found limited association between the intake of key foods related to a sustainable dietary pattern and attitudes towards environmentally friendly food. This could be due to limited, if any, awareness or understanding of what constitutes environmentally friendly food choices. To date in Australia there has been no public health campaigns educating people on what they can do to consume a sustainable diet. Given the high level of concern placed on the future food supply and importance of regulation of environmentally friendly food, public education campaigns promoting the nexus between a diet that is healthy for consumers and the environment may contribute to more healthful eating. This attitude-behavioural intention gap has been explored internationally in young people and found intentions to consume sustainable food is influenced by social pressure, perceived availability and knowledge of what constitutes sustainable food choices (Vermeir & Verbeke, 2006). To target future education programs to encourage healthy *and* sustainable dietary behaviours, further research is needed to investigate whether adults are more likely to adopt sustainable dietary behaviours if they are concerned about the effect of the environment on the future food supply, and which dietary changes they are amenable to.

A South Australian focus group study of 47 adults investigating community trust in the regulation of food production and supply found those living in metropolitan areas were more likely than those in rural areas to believe tighter regulation of the food supply is required (Meyer, Coveney, Henderson, Ward, & Taylor, 2012). These findings are consistent with the current study which shows that respondents residing in metropolitan areas were more likely than those in regional and remote areas to rate government regulation as very important ($p = 0.01$).

Lower income households were more likely to rate government control and regulation over an environmentally friendly food supply as ‘very’ important (52.1%) than high-income households (36.2%) ($p = .002$). Females were more likely to place importance on government regulation over an environmentally friendly food supply. In Western Australian households females are more likely to take responsibility for choosing, purchasing and preparing foods for the home (Pollard, Harray, et al., 2015), therefore they may have a higher interest and concern in the overall food environment.

The level of importance placed on government regulatory control may also be related to awareness of the importance and seriousness of the environmental impact of food, or a lack of knowledge

about what government regulation and control would involve. If the latter was a factor, these populations may have a greater desire for a body to regulate issues relating to the food supply, hence their response (Wilson, Meyer, Coveney, Henderson, & Ward, 2014). Regardless, our findings of a high level of importance Western Australian adults place on government regulation, suggests that policy makers should be confident when regulating this issue more and be encouraged to communicate any current actions in this area to the public. The findings of this study should be of interest to Government sectors with an interest in and who can influence sustainability and health, for example, Department's or Ministries of Health, Education, Primary Industries and Regional Development, Agriculture and Food, and Finance. Our findings suggest incorporating a specific dietary guideline on sustainable *and* healthy dietary practices into the next revision of the Australian Dietary Guidelines is warranted. Reporting on population perceptions of current policy issues related to diet and the food supply is a strength of this research.

There are a number of limitations that should be taken into consideration when interpreting the findings. Self-reported responses to the attitudinal questions may be influenced by social desirability, a sense of social responsibility as a result of increasing global awareness of sustainability and its importance (Vermeir & Verbeke, 2006). Respondents may have answered the questions in a way they believe they should (as a result of their knowledge), either intentionally or unintentionally (Cadmus-Bertram & Patterson, 2013). The possibility of social desirability bias may be a limitation of the survey question, however, the bias would exist across both surveys and about one quarter of respondents did not show concern. Another limitation is the potential for differing interpretations of the term 'environmentally friendly food'. However, the term was derived based on responses to open-ended questions asked in previous surveys, which asked about problems or concerns with the diet. The term 'environmentally friendly food' was not explained further, for example describing diets made up mostly of plant-based foods or minimally processed or packaged foods. It is recommended that this type of specification be made in future surveys. The median vegetable consumption of three servings a day in this study was comparable to those of the most recent national dietary survey based on 24 hour food recall, which found adult men and women consumed a daily mean of 2.3 serves and 2.5 serves of vegetables, respectively (Australian Bureau of Statistics, 2015). The finding of limited association with consumption of median fruit, vegetables or meat intake in the analyses could be attributed to the cut-off values as discussed in the methods section. Further research incorporating a wider range of sustainable dietary behaviours, such a food waste habits, fruit and vegetable seasonality and types of meat, poultry and fish consumed, in addition to a more comprehensive dietary assessment method, would be useful to gain an more in-depth understanding of associations between attitudes and behaviours relating to environmentally

friendly food. There is a need for ongoing research to support the agricultural, farming and food manufacturing practices that support an environmentally sustainable food supply.

Conclusion

Strengthening evidence on the impact of food production, processing and consumption habits on the environment is complemented by the high and increasing level of concern Western Australian adults place on an environmentally friendly food supply and the importance of government regulation of the issue. These findings support government efforts to regulate the supply of foods that support the environment. They also support the need to inform the community on how they can translate their concerns into healthier and more sustainable food choices. Further research to explore people's behaviour around healthy *and* sustainable diets and potential barriers to sustainable food consumption is recommended. Inclusion of specific dietary advice for a sustainable and healthy diet should be a priority in the next iteration of the Australian Dietary Guidelines.

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